

Appendix 9.8 2012 and 2013 Invertebrate Survey Reports

Commissioned by
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HIGHTOWN QUARRY MALLUSK (ANTRIM)

PRELIMINARY INVERTEBRATE SURVEY

Report number BS/2751/12

October 2012

Prepared by

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1 INTRODUCTION AND METHODOLOGY

1.1 Introduction

1.1.1 **Colin Plant Associates** were commissioned by **Ecology Solutions Ltd** to undertake an investigation of invertebrate habitats and species at Hightown Quarry, in Bogshell Road, Mallusk, near to Belfast in Northern Ireland.

1.2 Survey Constraints

1.2.1 Weather during the survey was unseasonally cold and a low cloud base meant that the site was enshrouded in mist for most of the day. Torrential rain fell during the overnight period and was accompanied by un-forecasted gale force winds.

1.2.2 Nevertheless, in spite of these sub-optimal conditions, the appraisal of the invertebrate macro-habitats and micro-habitats present is unaffected

1.3 Methodology

1.3.1 The site was visited on 6th and 7th September 2012. Terrestrial invertebrates were recorded by direct observations and by sweep netting. We also sampled using a suction sampler, to extract insects from crevices and other cryptic locations; this technique is particularly appropriate to the season of the year available for sampling.

Sweep-netting. A stout hand-held net is moved vigorously through vegetation to dislodge resting insects. The technique may be used semi-quantitatively by timing the number of sweeps through vegetation of a similar type and counting selected groups of species. This technique is effective for many invertebrates, including several beetle families, most plant bug groups and large number of other insects that live in vegetation of this type.

Suction Sampling consists of using a converted leaf blower to collect samples from grass and other longer ground vegetation. The sample is then everted into a net bag and the invertebrates removed with a pooter. The advantage of suction sampling is that it catches species which do not fly readily or which live in deep vegetation. It is particularly productive for Coleoptera and Homoptera.

1.3.2 Specific searching for the caterpillars of the Marsh Fritillary butterfly was also undertaken; this involved a hands-and-knees search of the Devil's-bit Scabious plants upon which they feed.

2 INVERTEBRATE RECORDING COMPARTMENTS

2.1 Overview

- 2.1.1 The quarry is extensive and presents a mosaic of hard rock cliffs, landslips and slopes and more or less level base areas that are situated at a number of different levels of excavated depth.
- 2.1.2 Above the cliffs that form the quarry's physical perimeter are areas of upland habitat including heather-dominated Upland Heath and grassland zones that give way to a pastoral landscape beyond the boundary of land ownership. A track gives access between the Upland Heath area and the quarry itself.
- 2.1.3 Static water bodies are also evident at the lower level within the survey area boundary.

2.2 The quarry bowl

- 2.2.1 Large areas of the site comprise completely bare, nutrient-poor ground that is unlikely to become even sparsely vegetated in the short term future. These areas are almost certainly of minimal invertebrate interest at the present.
- 2.2.2 A few small areas within the quarry are vegetated, some more densely than others. These tend to be landslip zones, spoil mounds, embankments or ditches at the sides of tracks and similar features.
- 2.2.3 These areas are likely to support the bulk of the invertebrate interest within the quarry itself, although this particular habitat resource is, overall, somewhat poorly represented.
- 2.2.4 Suction sampling was carried out on a representative selection of these vegetated areas and generated a less than spectacular list of 68 species. These are indicated in Appendix 1.

2.3 Upland heath and grassland areas

- 2.3.1 The semi-naturally grassland and heath habitat affects a restricted area within the perimeter fence at the top of the cliffs on the southern edge of the quarry. Heather dominates some parts; others are significantly encroached upon by Gorse scrub.
- 2.3.2 In one area on the south-eastern perimeter, scattered plants of Devil's-bit Scabious are evident in the grassy sward. These were hand-searched searched, specifically, for caterpillars of the Marsh Fritillary butterfly for a period of two hours. None were found. August is normally the best season for such searching, but at this northerly latitude and in a year that has been dominated by less than typical weather patterns, many invertebrates are approximately two weeks "behind schedule" so that we regard this date as entirely appropriate for this exercise and are able to conclude, within the normal bounds of difficulty in declaring a negative result, that the Marsh Fritillary butterfly is not currently represented in his upland heath zone of the site.
- 2.3.3 Suction sampling of the upland areas produced a combined list for the heather, grassland and other components of 57 invertebrate species; this list is perhaps shorter than might be expected in a year with more favourable weather conditions. Recorded species are indicated in Appendix 1.

2.4 Aquatic habitats

- 2.4.1 Static water-bodies are evident and these may support deep water. A peripheral zone of emergent vegetation is evident and it seems likely that these small lakes will support a significant range of invertebrates.
- 2.4.2 We did not sample the strictly aquatic invertebrates. Suction sampling of the amphibious zone was impractical (wet habitats are not best sampled using this technique). Site safety regulations prevented us from wading the marginal zones in order to investigate the amphibious invertebrate fauna.

3 DISCUSSION AND CONCLUSIONS

3.1 The quarry base

- 3.1.1 A total of 68 invertebrates recorded in the quarry base suggests, at least initially, that this section of the site may have raised invertebrate biodiversity and that is a situation which sits well with the experience of many entomologists who have been involved in assessing the ecological value of derelict quarries.
- 3.1.2 A closer examination, on the other hand, should take into account the fact that this sample was obtained from a rather restricted area within the quarry. It remains a fact that the bulk of the quarry base is quite devoid of any vegetation and thus has no current invertebrate interest.
- 3.1.3 This is not a surprising result. The greatest “problem” facing those wishing to develop former quarries lies in the fact that there is normally a significant interlude between cessation of quarrying and the arrival of the ecologist and it can scarcely be unexpected that during this period “nature” has taken over significant areas.
- 3.1.4 At Hightown Quarry, it is unclear to us how much time has elapsed since the end of quarrying activities, but it is self-evident that most of the quarry has not yet become vegetated. This delay may also be partly contributable to the fact that this is a “hard rock” quarry; softer substrates such as sand and chalk would be expected to colonise far more rapidly.
- 3.1.5 Our conclusion is that development within the bowl of Hightown Quarry is not likely to cause significant depletion of the invertebrate resource, provided that the loss of the few vegetated areas is appropriately mitigated. However, we caveat this statement with a recommendation that there should be minimal delay in the commencement of enabling works; if the quarry is left untouched for more than two or three years an ecological interest is likely to develop and that would necessitate additional investigation and a significantly greater level of mitigation input.

3.2 Upland heath areas

- 3.2.1 The upland heath area is largely degraded, but on the evidence of the single autumn sampling visit the small areas that are not may support a significant invertebrate interest. These are the more open areas of sparse heather and grassland (with Devil’s-bit Scabious) are largely concentrated in a single place at the head of a quarry access track.
- 3.2.2 These upland areas would benefit from some substantial management input, particularly the removal of gorse scrub, and may provide a potential area in which small losses elsewhere might be mitigated.
- 3.2.3 Some monitoring of the successes and failures of this mitigation process might be desirable, provided that the mitigation process itself is sufficiently flexible that recommended changes can be accommodated.

3.3 Aquatic habitats

- 3.3.1 The sub-aquatic invertebrate fauna is currently unknown. However, the marginal zones of water bodies are well-structured in places and are likely to support a suite of invertebrate species of at least local importance.
- 3.3.2 The water-bodies are to be retained and so there seems little need to have a specific knowledge of their invertebrate assemblage – this is unlikely to alter.
- 3.3.3 However, the ecological interest of the amphibious zones, particularly where there is a gradual transition through boggy ground before reaching dry land proper, is likely to be significant and ought to be safeguarded by the retention and enhancement of these places within the overall development.

APPENDIX

APPENDIX 1: INVERTEBRATE SPECIES RECORDED

National status codes are explained in Appendix 2.

Recording compartments

A = quarry floor

B = heather moorland above cliffs

Group / species	English name if available	National Status (GB)	Ecological associations and comments	Location	
				A	B
ARACHNIDA	SPIDERS				
Araneidae					
<i>Larinioides cornutus</i>			long grasses by water in wetland habitats		x
Clubionidae					
<i>Clubiona neglecta s.str.</i>		Local	sparsely vegetated ground.	x	
Gnaphosidae					
<i>Haplodrassus signifer</i>		Local	heathland and grassland		x
Linyphiidae					
<i>Bathyphantes gracilis</i>			low vegetation in general	x	
<i>Bathyphantes parvulus</i>			grasslands, both wet and dry	x	
<i>Bolyphantes luteolus</i>			grassland, moorlands and wet flushes, mainly north-western	x	
<i>Centromerita bicolor</i>			especially in disturbed grassland with open ground	x	
<i>Erigone atra</i>			ground level vegetation and under bark of fallen trees		x
<i>Erigone dentipalpis</i>		Local	ubiquitous species	x	x
<i>Erigone promiscua</i>			ground dwelling in a wide range of habitats, mainly north-western	x	x
<i>Lepthyphantes tenuis</i>	a spider		ubiquitous - often in grassland, but also a pioneer species	x	x
<i>Meioneta beata</i>		Local	Grassland		x
<i>Oedothorax apicatus</i>			open disturbed habitats	x	
<i>Oedothorax fuscus</i>			ubiquitous in grassland habitats, including lawns	x	x
<i>Stemonyphantes lineatus</i>			grassland and other open areas, especially chalk downland		x
Salticidae					
<i>Talavera aequipes</i>		Local	warm, open sites with bare surfaces such as short turf or bare sand		x
Tetragnathidae					
<i>Metellina segmentata s. str.</i>			ubiquitous	x	x
<i>Pachygnatha degeeri</i>			low vegetation		x
Thomisidae					
<i>Xysticus cristatus</i>			found in most non-shaded situations	x	x
COLEOPTERA	BEEYLES				
Apionidae	Seed weevils				
<i>Apion haematodes</i>			in the rootstock of <i>Rumex acetosella</i>		x
<i>Ceratapion gibbirostre</i>			thistles - in the stems. Was called <i>carduorum</i> in older texts.		x
<i>Ischneroapion virens</i>			Trifolium - larvae feeding inside the stems	x	
<i>Protapion assimile</i>			clover, especially red clover; widespread and common	x	x

Group / species	English name if available	National Status (GB)	Ecological associations and comments	Location	
				A	B
<i>Protapion fulvipes</i>			various clovers	x	x
<i>Holotrichapion pisi</i>			in the seed heads of Medicago	x	
Carabidae	Ground beetles				
<i>Notiophilus aquaticus</i>			usually in short, dry, open vegetation often at altitude	x	x
<i>Trechus quadristriatus</i>			ubiquitous in most open habitats during autumn	x	
Chrysomelidae	Leaf beetles				
<i>Lochmaea suturalis</i>	Heather Leaf-beetle		Heather		x
<i>Longitarsus flavicornis</i>			ragworts		x
<i>Longitarsus gracilis</i>			on ragwort	x	x
<i>Longitarsus jacobaeae</i>			Senecio jacobaeae	x	
<i>Longitarsus luridus</i>			widely polyphagous	x	
<i>Psylliodes napi</i>			various Cruciferae	x	
Coccinellidae	Ladybirds				
<i>Coccidula rufa</i>	Spotless ladybird		reed beds and other marshy places	x	
Cryptophagidae	fungus beetles				
<i>Micrambe vini</i>			unknown		x
Curculionidae	True weevils				
<i>Anthonomus rubi</i>			flowers of brambles and raspberries		x
<i>Hypera nigrirostris</i>			Trifolium pratense - on the foliage	x	
<i>Hypera postica</i>			Medicago, Melilotus and Trifolium - on the foliage	x	
<i>Sitona lepidus</i>			larvae feed in root nodules of legumes, especially clovers	x	
<i>Sitona lineatus</i>			various legumes	x	
<i>Tachyerges salicis</i>			sallows and willows		x
Hydrophilidae					
<i>Megasternum concinnum</i> (= <i>obscurum</i>)			organic mud and wet (liquid) decaying vegetation	x	x
Phalacridae	smut beetles				
<i>Olibrus aeneus</i>			flowers of various Compositae, especially Matricaria, Artemisia and Tanacetum	x	
Ptiliidae	Feather-wing beetles				
<i>Acrotrichis fascicularis</i>			grassland, sometimes woodland, on decaying vegetation	x	x
Staphylinidae	Rove beetles				
<i>Atheta (Mocyta) fungi</i>			a detritus-feeding rove beetle	x	x
<i>Micropeplus staphylinoides</i>		Local	rotting vegetation, grass tussocks or occasionally on bare mud		x
<i>Sepedophilus nigripennis</i>			grass tussocks, leaf litter, mosses and similar places		x
<i>Stenus brunripes</i>			leaf litter, flood debris, tussocks etc	x	
<i>Stenus clavicornis</i>			marshy places	x	x
<i>Stenus fulvicornis</i>			usually in marshy places	x	x
<i>Stenus impressus</i>			usually in marshy places		x
<i>Stenus junco</i>			found in wet habitats	x	x
<i>Stenus latifrons</i>			damp habitats		x
<i>Stenus nanus</i>			hay bales, silage, hedgerows etc	x	
<i>Stenus ossium</i>			litter and moss - becoming rarer towards the north	x	
<i>Stenus picipes</i>			leaf litter, flood debris, tussocks etc, but mostly in woodlands		x

Group / species	English name if available	National Status (GB)	Ecological associations and comments	Location	
				A	B
<i>Tachyporus chrysomelinus</i>			grass litter and tussocks		x
<i>Tachyporus nitidulus</i>			leaf litter, grass tussocks and similar micro-habitats	x	
DERMAPTERA	EARWIGS				
Forficulidae					
<i>Forficula auricularia</i>	common earwig		generalist species	x	x
DIPTERA	TRUE FLIES				
Syrphidae	Hoverflies				
<i>Episyrphus balteatus</i>			ubiquitous species, partly immigrant, and a predator of aphids	x	x
<i>Eupeodes corollae</i>			Grassland	x	
<i>Helophilus pendulus</i>			Larvae require damp habitats but adults are more or less ubiquitous	x	x
<i>Melanostoma mellinum</i>			Grassland	x	
<i>Melanostoma scalare</i>			Grassland	x	x
<i>Sericomyia lapponica</i>					x
HETEROPTERA	PLANT BUGS				
Anthocoridae					
<i>Anthocoris nemoralis</i>			trees and shrubs		x
<i>Anthocoris nemorum</i>			low vegetation	x	
Berytinidae					
<i>Berytinus minor</i>			damp habitats, usually with White Clover	x	
Lygaeidae					
<i>Scolopostethus decoratus</i>			associated with heath on heath and moor		x
<i>Stygnocoris sabulosus</i>			disturbed ground amongst ruderal plants	x	x
Miridae					
<i>Lygus maritimus</i>			Chenopodiaceae - in coastal sites and inland ruderal sites	x	
<i>Lygus rugulipennis</i>			polyphagous - especially common in ruderal communities	x	
<i>Mecomma ambulans</i>			feeds on sap of sedges, rushes and other plants, as well as on animal matter		x
<i>Stenodema calcaratum</i>			grasslands	x	
<i>Stenodema holsata</i>			grasslands, usually damp. Mainly northern and western	x	x
<i>Stenodema laevigatum</i>			grasslands	x	
Nabidae					
<i>Nabis flavomarginatus</i>			predatory species		x
<i>Nabis limbatus</i>	marsh damsel bug		marshy places	x	
Saldidae					
<i>Saldula orthochila</i>			predatory species of damp habitats	x	
Tingidae					
<i>Acalyptus parvula</i>			amongst moss in dry situations		x
HOMOPTERA	FROGHOPPERS				
Aphrophoridae					
<i>Neophilaenus lineatus</i>			grasslands	x	x
<i>Philaenus spumarius</i>	spittle-bug/Cuckoo-spit bug		larvae feed under froth on a wide range of herbaceous plants	x	x
Cicadellidae					
<i>Anoscopus flavostriatus</i>			grassland		x

Group / species	English name if available	National Status (GB)	Ecological associations and comments	Location	
				A	B
<i>Aphrodes bicinctus</i>		Local	grasses in dry situations	x	
<i>Aphrodes makarovi</i>			grasslands	x	x
<i>Cicadella viridis</i>	a froghopper		grasses and rushes in marshy places	x	
<i>Elymana sulphurella</i>			dry grassland		x
<i>Eupteryx urticae</i>	a froghopper		Usually on nettles	x	
<i>Macrosteles sexnotatus</i>			grassland species often associated with clovers	x	
<i>Megophthalmus scanicus</i>			associated with Fabaceae (clovers, trefoils, medics etc) in grassland	x	x
<i>Streptanus sordidus</i>			grasses in a range of habitats		x
Delphacidae					
<i>Javesella pellucida</i>			grasses in a range of habitats	x	
<i>Muellerianella fairmairei</i>			damp grasslands	x	x
LEPIDOPTERA	MOTHS				
Noctuidae					
<i>Xestia xanthographa</i>	Square-spot Rustic		grasses and herbaceous plants then trees in the spring	x	
MYRIAPODA:	MILLIPEDES				
DIPLPODA					
Julidae					
<i>Cylindroiulus punctatus</i>			a woodland species, sometimes associated with non-woodland trees	x	
<i>Tachypodoiulus niger</i>			many habitats and often found climbing trees	x	
NEUROPTERA	LACEWINGS				
Chrysopidae					
<i>Chrysoperla carnea</i>			aphid predator of trees and bushes	x	x

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INVERTEBRATE SURVEY

**FINAL REPORT
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ACKNOWLEDGEMENTS

Field work for this project has been undertaken by

Colin W. Plant

Colin Plant Associates (UK) are pleased to credit the input of the following personnel for participation in the identification of invertebrate samples

Tristan Bantock (Hemiptera)
Peter Chandler (Diptera)
Norman F. Hall (Coleoptera)
Edward Milner (Arachnida)

1 INTRODUCTION AND METHODOLOGY

1.1 Introduction

1.1.1 **Colin Plant Associates** were commissioned by **Ecology Solutions Ltd** to undertake an investigation of invertebrate habitats and species at Hightown Quarry, in Bogshill Road, Mallusk, near to Belfast in Northern Ireland.

1.2 Methodology

1.2.1 The site was visited on three occasions across two calendar years, in order that a cross-seasonal representation of invertebrate species could be obtained in samples collected. The visit dates were:

- 6th and 7th September 2012
- 1st and 2nd July 2013
- 19th and 20th August 2013.

1.2.2 The omission of sampling during the months of May and June is explained below under the heading of Survey Constraints.

1.2.3 Active sampling of terrestrial invertebrates was undertaken by direct observations, by sweep netting and the use of beating trays and by using a suction sampler, to extract insects from crevices and other cryptic locations. These techniques are described, briefly, as follows:

- **Sweep-netting.** A stout hand-held net is moved vigorously through vegetation to dislodge resting insects. The technique may be used semi-quantitatively by timing the number of sweeps through vegetation of a similar type and counting selected groups of species. This technique is effective for many invertebrates, including several beetle families, most plant bug groups and large number of other insects that live in vegetation of this type.
- **Beating trees and bushes.** A cloth tray, held on a folding frame, is positioned below branches of trees or bushes and these are sharply tapped with a stick to dislodge insects. Black or white trays are used depending upon which group of invertebrates has been targeted for search. Insects are collected from the tray using a pooter. This technique is effective in obtaining records of most arboreal species, including many beetle groups, bugs, caterpillars of Lepidoptera, spiders and others. It can be undertaken at any site where there are trees or bushes present although is rendered ineffective if the vegetation is wet or if the weather is windy.
- **Suction Sampling** consists of using a converted leaf blower to collect samples from grass and other longer ground vegetation. The sample is then everted into a net bag and the invertebrates removed with a pooter. The advantage of suction sampling is that it catches species, which do not fly readily or which live in deep vegetation. It is particularly productive for Coleoptera, some Diptera and Arachnida.

1.2.4 In addition, we set a number of passive traps that could operate continuously between site visits so that the results were less dependant upon recorder-effort. These included pitfall traps and a Malaise trap. These techniques are now described:

- **Pitfall trapping.** Vending-machine cups or similar are placed in the ground with the rim flush with, or slightly below, the surface. A fluid is added, containing ethylene glycol, sodium chloride and formalin with a little detergent to reduce surface tension. Traps may be covered or uncovered and are typically left in position for a month at a time. Holes made in the sides of the cups a couple of centimetres below the rim permit flood or rain water to drain without the traps over-flowing and the catch becoming lost. Invertebrates simply fall into the traps. Traps were set in pairs at various stations across the site.
- **Malaise trapping.** A tent-like net is erected on poles, using guy ropes, in the habitat to be sampled. The two, long side walls of the tent are absent and a long central wall is present. Insects collide with the central net wall and are funnelled upwards to a catching chamber. Traps are usually left all year and catching chamber, which is charged with isopropyl alcohol (propan-2-ol), emptied fortnightly or monthly depending on site, habitat and weather. This method almost always generates huge volumes of material and several days are normally required to sort and identify material from a single trap session. It is the single most effective sampling method for all flying insects and frequently catches insects that have not been found by any other method.

1.2.6 We also undertook overnight moth recording using two types of light trap to obtain maximum return.

- **MV light-trapping.** Mercury-vapour (mv) light bulbs are used to attract nocturnal insects - especially moths. These bulbs emit ultra-violet light at a wavelength which causes moths to be attracted but the wavelength used is harmless to humans. The bulbs are mounted over catching chambers filled with cardboard egg-trays and moths entering the chambers settle on these trays and may be examined. Bulbs were powered from portable generators. Light trapping is the single most effective method of recording moths. It is also valuable for recording some other
- **Actinic light trapping.** Small size actinic traps, operated from 12 volt burglar-alarm batteries were left running from early evening to the following morning. These units are discrete because, whilst still having an output in the safe zone of the UV range, their light output in the visible part of the spectrum is reduced; thus, they can be tucked away in undergrowth at the side of a track without passers-by noticing them. For the same reasons of light emission, they attract moths and other insects from a much shorter distance and so the resultant catch is usually more representative of the habitat selected, in comparison with that in mercury vapour traps which attract flying species from a much wider area of the countryside.

1.2.7 Nine light traps, comprising 3 mv lamps and six actinic units, were operated on each date.

1.2.8 The positions of the pitfall traps, malaise trap and the light traps are indicated in Map 1.

1.3 Survey Constraints

- 1.3.1 Our interim report at the end of the autumn 2012 session emphasised the negative impact of the general weather pattern during 2012 on the survey. Following one of the wettest summers on record, the autumn was exceptionally cold and during the September visit, which had necessarily been fixed in advance, torrential rain during the overnight period was accompanied by un-forecasted gale force winds placing significant physical restrictions on survey effort.
- 1.3.2 As a result of this, invertebrate numbers were undeniably depressed and our samples from Hightown bore out this general situation; it was inevitable that we advised additional survey during 2013.
- 1.3.3 It is regrettable, therefore, that following the wettest spring on record in 2012, that season during 2013 was officially registered as the coldest on record. Invertebrate activity was severely depressed, not least because although there were some memorably warm days the overnight temperature often fell so low that survival on the part of some species was negatively affected.
- 1.3.4 This situation persisted until the end of June. At the start of July the weather suddenly and dramatically switched to being atypically hot and sunny. The recommended additional work was commissioned in mid-June and so we were able to make a site visit at the start of this better weather.
- 1.3.5 However, because one of the evident longer term effects of the poor weather was to delay insect development (from egg to adult) by up to three weeks, the species encountered during both the July and August visits were not necessarily those expected at those dates. This has bearing on our results. However, this generally negative situation has affected all sites across Britain, presumably at equal level, and so we are firmly of the opinion that our results are fully representative of the ecology of this particular site and may thus be used, safely, in site analysis.

2 INVERTEBRATE RECORDING COMPARTMENTS

2.1 Overview

- 2.1.1 The quarry is extensive and presents a mosaic of hard rock cliffs, landslips and slopes and more or less level base areas that are situated at a number of different levels of excavated depth.
- 2.1.2 Above the cliffs that form the quarry's physical perimeter are areas of upland habitat including heather-dominated Upland Heath and grassland zones that give way to a pastoral landscape beyond the boundary of land ownership. A track gives access between the Upland Heath area and the quarry itself.
- 2.1.3 Static water bodies are also evident at the lower level within the survey area boundary.

2.2 The quarry bowl

- 2.2.1 Large areas of the site comprise completely bare, nutrient-poor ground that is unlikely to become even sparsely vegetated in the short term future. These areas are almost certainly of minimal invertebrate interest at the present.
- 2.2.2 A few small areas within the quarry are vegetated, some more densely than others. These tend to be landslip zones, spoil mounds, embankments or ditches at the sides of tracks and similar features.
- 2.2.3 These areas are likely to support the bulk of the invertebrate interest within the quarry itself, although this particular habitat resource is, overall, somewhat poorly represented.

2.3 Upland heath and grassland areas

- 2.3.1 The semi-natural grassland and heath habitat affects a restricted area within the perimeter fence at the top of the cliffs on the southern edge of the quarry. Heather dominates some parts; others are significantly encroached upon by Gorse bushes.
- 2.3.2 In one area on the south-eastern perimeter, scattered plants of Devil's-bit Scabious are evident in the grassy sward. These were hand-searched searched, specifically, for caterpillars of the Marsh Fritillary butterfly during all site visits.

2.4 Aquatic habitats

- 2.4.1 Two adjacent quarry lakes are evident in the north-west corner of the site. These have a peripheral zone of emergent vegetation and it seems likely that these small lakes will support a significant range of invertebrates. For practical reasons, so specific sampling of truly aquatic invertebrates was undertaken. However, the peripheral zone was sampled and several "amphibious" species are included in the final inventory.
- 2.4.2 To the west of the weighbridge area two lagoons are also present. These may contain deep water and are accessible only via the steep earth banks. These were not sampled for aquatic species, but during the August 2013 visit we established light traps in this area, potentially to record adult stages of some aquatic species.

3 RESULTS OF TERRESTRIAL INVERTEBRATE SAMPLING

3.1 Overview

3.1 Appendix 1 reports the complete list of the 355 insect taxa encountered during the survey.

3.2 Invertebrate biodiversity in Northern Ireland

- 3.2.1 The list is annotated with formal National Status codes where these are better than “nationally common” and these status codes are explained in Appendix 2. However, this requires interpretation in relation to Northern Ireland. The following information has been taken from the web site of Northern Ireland Planning (accessed 26th September 2013), a governmental department, at <http://www.planningni.gov.uk/downloads/northern2016-techsupp-10-countryside-assessment.pdf>
- 3.2.2 Although elements of the Natural Environment and Rural Communities (NERC) Act 2006 apply to Northern Ireland, including Section 40 which extends to all public authorities the duty to have regard to biodiversity as far as is consistent with the proper exercise of their functions, there is no list of Species of Principal Importance in Ireland listed within that Act and the Irish planning legislation in relation to invertebrates has a different basis.
- 3.2.3 Following the recommendations of the Northern Ireland Biodiversity Group (NIBG), set up in 1996 to address development of strategies for biodiversity conservation, the Northern Ireland Biodiversity Strategy was published in 2002. This Strategy focuses on the importance of conserving biological diversity and conservation in the period up to 2016.
- 3.2.4 The Environment and Heritage Service (DOE) Biodiversity Strategy Implementation Plan 2002/2005 contains recommendations for the protection and restoration of habitats and species, and the first 12 Northern Ireland Habitat Action Plans were published in March 2003.
- 3.2.5 Although the proportion of UK priority species present in Northern Ireland is small, it does not follow that species are consequently of less overall concern. There are at least two reasons why this is so: The presence of a species in Northern Ireland contributes to the maintenance of its range; it may also play a part in maintaining its internal genetic diversity. The latter reason applies most obviously to those species where the Irish populations are known to be genetically distinct from the British ones. A further reason is that for some species, Northern Ireland is a stronghold and thus represents an important bulwark against potential or actual threats.
- 3.2.6 The formal selection of species of conservation concern in Northern Ireland was based on a set of six criteria; included taxa must meet one or more of these conditions:
- be listed as priority species in the UK;
 - be listed in an Irish Red Data Book or otherwise identified as of conservation concern in Ireland as a whole;
 - be scarce, rare, or declining in Northern Ireland;
 - have a large proportion of their International, UK or Irish population in Northern Ireland;
 - be genetically distinct in Ireland (e.g. Irish sub-species); or
 - be functionally critical to ecosystems.

- 3.2.7 The list has been further narrowed down by selecting as priority species only those for which there was reliable evidence of vulnerability or decline. Included as appropriate evidence is that species
- are UK priority species;
 - are listed as endangered in an Irish Red Data Book;
 - are rapidly declining in Northern Ireland or Ireland;
 - have more than 20% of their total UK population in Northern Ireland and are rare or declining; or
 - have more than 50% of their Irish population in Northern Ireland and are rare or declining.
- 3.2.8 We have taken this to mean that species included in either Section 41 (Species of Principal Importance in England) or Section 42 (Species of Principal Importance in Wales) of the Natural Environment and Rural Communities (NERC) Act 2006 apply to Northern Ireland.
- 3.2.9 Planning Northern Ireland make it clear that the selection of Northern Ireland priority species should be seen as provisional and will be included within a proposed review of species of conservation study to be undertaken by the Northern Ireland Biodiversity Group.

3.3 Species of conservation interest recorded at Hightown Quarry

- 3.3.1 The categories of invertebrates are of raised significance in an ecological assessment are now examined.

Legally Protected Species

- 3.3.2 No invertebrate species that are afforded direct legal protection under any UK or European legislation were encountered during the survey; none are likely to have been overlooked. Specifically, we did not record the presence of the Marsh Fritillary butterfly, which is afforded a measure of protection by its inclusion in Annexe II of the *Berne Convention on the Conservation of European Habitats and Wildlife* and in Annexe II of the *European Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora* (known generally as the *European Habitats and Species Directive*).

UK Biodiversity Action Plan (UK BAP) Priority Species/Section 41 Species

- 3.2.3 The definition of these species has been discussed above at paragraphs 3.2.2 to 3.2.9. No such Species were recorded during the present survey.
- 3.2.4 The list of UK Biodiversity Action Plan Priority Species *of moths* is divided into two sections. In the first, a total of 81 species are afforded the status of UK BAP Priority Species; none of these is recorded in the surveyed area nor is any likely to be present.
- 3.2.5 The second section is a list of 69 species that have declined in population strength by a significant amount in the past 25 years. These are not yet rare and are flagged as UK BAP species “**for research only**”.

3.2.6 Thirteen such “Research Only” moth species is recorded; several others are confidently predicted to be present. All were caught in the light traps and so cannot be allocated to a specific area other than by an opinion based on the caterpillar food plants, which are listed below.

Species	Caterpillar feeds on
<i>Acrionicta psi</i>	leaves of deciduous trees and bushes
<i>Apamea remissa</i>	grasses
<i>Celaena leucostigma</i>	Iris pseudacorus, and probably other wetland plants
<i>Chiasmia clathrata</i>	Medicago, Trifolium
<i>Ecliptopera silaceata</i>	willow herbs, enchanter's nightshade
<i>Hepialus humuli</i>	roots of grasses and herbaceous plants
<i>Melanchra pisi</i>	widely polyphagous, including on bracken
<i>Scotopteryx chenopodiata</i>	vetches and clovers
<i>Spilosoma lubricipeda</i>	herbaceous plants
<i>Spilosoma lutea</i>	herbaceous plants and also trees and shrubs
<i>Stilbia anomala</i>	grasses, especially <i>Deschampsia cespitosa</i>
<i>Xanthia ictertia</i>	sallow/willow catkins - then on herbaceous plants
<i>Xanthorhoe ferrugata</i>	herbaceous plants

Red Data Book Species

3.2.7 One species listed in the British Red Data Books (Shirt, 1987; Bratton, 1991) or which have been elevated to the status of Critically Endangered, Endangered, Nationally Vulnerable or Near Threatened (formerly Nationally Rare) by subsequent formal reviews is so far recorded in the present survey.

Red Data Book category K – Indeterminate

Heleomyza captiosa (Heleomyzidae) The ecological associations of this species are currently unclear. It has recently been separated as a valid species from *Heleomyza serrata* which is a widespread and common species whose larvae feed in dung and decomposing vegetable matter.

Nationally Scarce Species

3.2.8 Three of the species recorded feature in the Nationally Scarce (formerly Nationally Notable - Nb) category (see Appendix 2). These are summarised in the table below:

Key to locality codes:

- 1: Within the quarry itself
- 2: Vegetated areas above the quarry cliffs
- 3: Caught in the Malaise trap (see Map 1)
- 4: Caught in the various light traps (see map 1)

Species	Ecological associations	Location			
		1	2	3	4
<i>Deleaster dichrous</i>	under stones, logs etc at the edge of wet areas				x
<i>Meligethes fulvipes</i>	associated with Charlock and perhaps other yellow flowered Brassicaceae				x
<i>Tetanocera punctifrons</i>	predator of snails in damp areas near running water			x	

Nationally Local Species

3.2.9 Fourteen of the recorded species are listed formally as Nationally Local (see Appendix 2). These are summarised in the following table:

Key to locality codes:

- 1: Within the quarry itself
- 2: Vegetated areas above the quarry cliffs
- 3: Caught in the Malaise trap (see Map 1)
- 4: Caught in the various light traps (see map 1)

Species	Ecological associations	Location			
		1	2	3	4
<i>Acidia cognata</i>	Tussilago and Petasites plants - mining the leaves			x	
<i>Aphrodes bicinctus</i>	grasses in dry situations	x			
<i>Chelipoda vocatoria</i>	predatory species of damp habitats			x	
<i>Clubiona neglecta</i> s.str.	sparsely vegetated ground	x			
<i>Dolichocephala oblongoguttata</i>	ecology unclear			x	
<i>Erigone dentipalpis</i>	ubiquitous species	x	x		
<i>Haplodrassus signifer</i>	heathland and grassland	x			
<i>Limnophora triangula</i>	larval ecology unclear			x	
<i>Lophosceles mutatus</i>	larval ecology unclear			x	
<i>Meioneta beata</i>	Grassland		x		
<i>Micropeplus staphylinoides</i>	rotting vegetation, grass tussocks or occasionally on bare mud		x		
<i>Rhamphus oxyacanthae</i>	larva mines in leaves of hawthorn			x	
<i>Scellus notatus</i>	predatory species in woodland and scrub, the adults predatory			x	x
<i>Talavera aequipes</i>	warm, open sites with bare surfaces such as short turf or bare sand		x		

Species in some other way interesting or important

3.2.10 Four of the species recorded are new to Ireland, having never before been encountered in either the North or in Eire. All were caught in the Malaise trap.

- ***Orfelia lugubris*** (Keroplastidae), formerly called *Orfelia tristis*, is a widespread and common species in Great Britain; it has probably been overlooked in Northern Ireland.
- ***Cerodontha iridis*** (Agromyzidae) is a minute fly whose larvae feed internally in the leaves of *Iris foetidissima*, creating white galleries, or “mines”. The foodplant grows near the malaise trap that caught it; the Agromyzidae as a whole are very poorly recorded and the discovery is not one of profound ecological interest.

- ***Phytomyza pullula*** (Agromyzidae) is another whose larvae feed internally in the leaves of its host plant, in this case Scentless Mayweed, which grows in various parts of the quarry base. As with *Cerodontha iridis* this discovery is not one of profound ecological interest.
- ***Heleomyza captiosa*** (Heleomyzidae) is a fly that is probably widespread in Ireland. It has recently been separated as a valid species from *Heleomyza serrata* which is widely recorded in Ireland as a whole; the segregate is undoubtedly awaiting discovery by specialist entomologists.

4 DISCUSSION

4.1 Introductory remarks

- 4.1.1 That there were a number of constraints that adversely affected the results of survey work is as undeniable as it was unavoidable. Nevertheless, a total of 355 invertebrate species was recorded and that is a moderately high total in relation to the survey effort expended on a site at this fairly northerly latitude.
- 4.1.2 It can be concluded as a result that whilst the list presented in Appendix 1 is, undoubtedly, something short of a complete species inventory it is, nevertheless, a representative “snapshot” of the invertebrate assemblage of the surveyed area.
- 4.1.3 The number of species deemed to be of raised conservation significance is relatively low, but it should be borne in mind that the altitude and the latitude of the site inevitably preclude the higher percentages that are expected on more southerly, lowland sites.
- 4.1.4 The contribution to the inventory made by the malaise trap is clear from Appendix 1. However, flight interception trapping such as this is not wholly site-specific, since it catches insects flying through the catch area. It may, nevertheless, be indicative of the species present in general area. This non-specificity can be minimised by careful positioning of the trap and for the present survey this was placed, deliberately, in a small, damp gully, overhung by trees and in a position where flying insects moving across the wider landscape might be less expected than insects that were moving about the different habitat areas of the site.
- 4.1.5 Similar comments apply to insects captured in light traps and moths, in particular, might be drawn down from the “aerial plankton” in the sky over the quarry. Nevertheless, in an area that is dominated by upland heath and pasture there is a significantly high proportion of wetland species in the catch, suggesting that the water bodies in the surveyed area may be the source.
- 4.1.6 A closer look at the ecological associations of all the recorded species during the survey (Appendix 1) suggests that the three primary areas of the site make unequal contributions to the overall ecological interest. This is explored using an ISIS analysis.

4.2 ISIS analysis

- 4.2.1 The Invertebrate Species-habitats Information System (ISIS) is a tool used to undertake common standards monitoring (i.e. monitors the condition of invertebrate assemblages), scores them based on the invertebrate assemblage types present (similar to how the NVC is used to assess plant communities) and evaluates their conservation value *within context*.
- 4.2.2 The ISIS tool was used on the data recorded at Hightown Quarry in order to statistically interpret the survey results and highlight any significant trends or changes for the data reported.
- 4.2.3 The ISIS assemblage types are defined by lists of characteristic species that are generally found together in nature. There are two categories:

- **Broad Assemblage Types (BATs)** are a comprehensive series of assemblage types that are characterised by more widespread species.
- **Specific Assemblage Types (SATs)** are characterised by ecologically restricted or stenotopic species of intrinsic nature conservation value.

4.2.4 Some of the scoring systems used in ISIS can be influenced by target group, sampling effort or seasonal factors. Consistent for surveys was the discussion of the exceptionally poor weather, which had significant adverse effects on invertebrates across the UK in general, and as a constraint in survey findings with many species represented in hugely reduced numbers and others apparently absent. Numbers of individuals in many insect groups were depressed below the norm.

4.3 The quarry base

4.3.1 A total of only 73 species was recorded within the quarry base, representing only 20% of the inventoried species. An examination of their primary ecological associations shows that these are a mix of generalist and ubiquitous species together with a large number that are associated with ruderal vegetation communities.

4.3.2 This comes as no particular surprise, since most of the quarry floor is quite bare. Of course, bare ground is an important feature of post-industrial sites, but at this particular derelict, hard rock quarry it probably makes minimal contribution.

4.3.3 Applying the ISIS analysis reveals that the Broad Assemblage Types represented are as follows:

BAT name	Representation (1-100)	Rarity score	Condition	BAT species richness
grassland & scrub matrix	5	113		38
unshaded early successional mosaic	1			6
permanent wet mire	1			4

4.3.4 The absence of any entry in the “Condition” column indicates that the BAT does not achieve favourable condition, although the number of species used is far too low for any reliance to be placed on the results in isolation. However, two of the three BATs identified, the “grassland & scrub matrix” and the “unshaded early successional mosaic” are identified as being of significance; this accords with the visual interpretation mentioned above. The third BAT, that of “permanent” wet mire” doubtless reflects the presence of species wandering from the two wetland areas nearby.

4.3.5 Our conclusion is that a development in the bowl of Hightown Quarry is not likely to cause significant depletion of the invertebrate resource, provided that the loss of the few vegetated areas is appropriately mitigated.

4.4 Upland heath areas

- 4.4.1 The upland heath area on the cliff tops around the quarry, is perhaps degraded in places but nevertheless supports an invertebrate interest.
- 4.4.2 Only 61 species were found specifically in this area, although some from the malaise traps may belong here. The results of an ISIS analysis identify species of “scrub-heath and moorland” as being the important component of the invertebrate interest, although apparently not currently in favourable condition.

SAT name	No. spp.	Condition	% of national species pool
scrub-heath & moorland	7		2
rich flower resource	3		1
dung	1		1
scrub edge	1		1
open short sward	1		0
bare sand & chalk	1		0
bark & sapwood decay	1		0

- 4.4.3 Careful and repeated survey for Marsh Fritillary butterfly here suggests that this species is absent from the surveyed area in 2012 and 2013.

4.5 Aquatic habitats

- 4.5.1 The sub-aquatic invertebrate fauna remains unknown. However, the marginal zones of water bodies are well-structured in places and are likely to support a suite of invertebrate species of at least local importance.
- 4.5.2 This is supported by the presence of a reasonably large number of wetland associates in both the malaise trap and the moth traps. Separating these species out for discussion would be a fairly arbitrary exercise, but subjecting the entire recorded species inventory to ISIS analysis shows three wetland Broad Assemblage Types, “permanent wet mire”, “flowing water” and “mineral marsh and open water” as being of importance here.

BAT name	Representation (1-100)	Rarity score	Condition	BAT species richness
grassland & scrub matrix	10	117		94
permanent wet mire	3	148		23
arboreal canopy	2	114		21
flowing water	2	132		19
mineral marsh & open water	1			12
unshaded early successional mosaic	1			11
shaded field & ground layer	1			8

5 CONCLUSIONS

5.1 The following conclusions are, therefore, offered:

- It seems unlikely that major losses from the overall invertebrate-based ecological interest would result from the development of the quarry as proposed.
- However, there are several small, isolated marginal areas that have a raised interest and these will probably be lost.
- The wetland assemblage of invertebrates shows signs of significance
- Similarly, the upland heath/moorland areas above the quarry also make a significant contribution.
- In our opinion, the small losses to the marginal areas of the quarry could be adequately mitigated by habitat enhancement in the wetland and upland heath/moorland zones.

APPENDICES

MAP 1: THE SURVEYED AREA, SHOWING POSITIONS OF STATIC TRAPS



APPENDIX 1: LIST OF INVERTEBRATES RECORDED

National status codes are explained in Appendix 2.

Key to locality codes:

- 1: Within the quarry itself
- 2: Vegetated areas above the quarry cliffs
- 3: Caught in the Malaise trap (see Map 1)
- 4: Caught in the various light traps (see map 1)

Group / species	National status	Ecological associations	Location			
			1	2	3	4
ARACHNIDA						
Araneidae						
<i>Larinioides cornutus</i>		long grasses by water in wetland habitats		x		
Clubionidae						
<i>Clubiona neglecta</i> s.str.	Local	sparsely vegetated ground.	x			
Gnaphosidae						
<i>Haplodrassus signifer</i>	Local	heathland and grassland	x			
Linyphiidae						
<i>Bathyphantes gracilis</i>		low vegetation in general		x		
<i>Bathyphantes parvulus</i>		grasslands, both wet and dry	x			
<i>Bolyphantes luteolus</i>		grassland, moorlands and wet flushes, mainly north-western	x			
<i>Centromerita bicolor</i>		especially in disturbed grassland with open ground	x			
<i>Erigone atra</i>		ground level vegetation and under bark of fallen trees		x		
<i>Erigone dentipalpis</i>	Local	ubiquitous species	x	x		
<i>Erigone promiscua</i>		ground dwelling in a wide range of habitats, mainly north-western	x	x		
<i>Lepthyphantes tenuis</i>		ubiquitous - often in grassland, but also a pioneer species	x	x		
<i>Meioneta beata</i>	Local	Grassland		x		
<i>Oedothorax apicatus</i>		open disturbed habitats	x			
<i>Oedothorax fuscus</i>		ubiquitous in grassland habitats, including lawns	x	x		
<i>Stemonyphantes lineatus</i>		grassland and other open areas, especially chalk downland		x		
Salticidae						
<i>Talavera aequipes</i>	Local	warm, open sites with bare surfaces such as short turf or bare sand		x		
Tetragnathidae						
<i>Metellina segmentata</i> s. str.		ubiquitous	x	x		
<i>Pachygnatha degeeri</i>		low vegetation		x		
Thomisidae						
<i>Xysticus cristatus</i>		found in most non-shaded situations	x	x		
COLEOPTERA						
Apionidae						
<i>Apion haematodes</i>		in the rootstock of <i>Rumex acetosella</i>		x		
<i>Ceratapion gibbirostre</i>		thistles - in the stems		x		
<i>Holotrichapion pisi</i>		seed heads of <i>Medicago</i>	x			
<i>Ischneroapion virens</i>		<i>Trifolium</i> - larvae feeding inside the stems	x			
<i>Protapion assimile</i>		clover, especially red clover; widespread and common	x	x		
<i>Protapion fulvipes</i>		various clovers	x	x		
Byturidae						

<i>Byturus tomentosus</i>		Brambles and raspberries			x	
Cantharidae						
<i>Cantharis cryptica</i>		tall vegetation, especially at the woodland/grassland interface			x	
<i>Cantharis pallida</i>		widespread wetland species				x
<i>Rhagonycha fulva</i>		tall, rank vegetation in lowland areas			x	
Carabidae						
<i>Elaphrus cupreus</i>		species of bare ground by standing water but preferring this to be shaded			x	
<i>Nebria (Nebria) brevicollis</i>		ubiquitous late summer and autumn species				x
<i>Notiophilus aquaticus</i>		usually in short, dry, open vegetation often at altitude	x	x		
<i>Trechus quadristriatus</i>		ubiquitous in most open habitats during autumn	x			
Chrysomelidae						
<i>Lochmaea suturalis</i>		Heather			x	
<i>Longitarsus flavicornis</i>		ragworts			x	
<i>Longitarsus gracilis</i>		on ragwort	x	x		
<i>Longitarsus jacobaeae</i>		Senecio jacobaeae	x			
<i>Longitarsus luridus</i>		widely polyphagous	x			
<i>Psylliodes napi</i>		various Cruciferae	x			
Coccinellidae						
<i>Coccidula rufa</i>		reed beds and other marshy places	x			
Cryptophagidae						
<i>Micrambe vini (= ulicis)</i>		associate with Gorse			x	x
Curculionidae						
<i>Anthonomus pedicularis</i>		larvae develop in hawthorn berries				x
<i>Anthonomus rubi</i>		flowers of brambles and raspberries			x	
<i>Hypera nigrirostris</i>		Trifolium pratense - on the foliage	x			
<i>Hypera postica</i>		Medicago, Melilotus and Trifolium - on the foliage	x			
<i>Orobitis cyaneus</i>		larvae feed inside the seeds capsules of various violet species			x	
<i>Rhamphus oxyacanthae</i>	Local	larva mines in leaves of hawthorn				x
<i>Sitona lepidus</i>		larvae feed in root nodules of legumes, especially clovers	x			
<i>Sitona lineatus</i>		various legumes	x			
<i>Tachyerges salicis</i>		sallows and willows			x	
Hydrophilidae						
<i>Megasternum concinnum (= obscurum)</i>		organic mud and wet (liquid) decaying vegetation	x	x		
Leiodidae						
<i>Leiodes calcarata</i>		associated with fungi				x
Nitidulidae						
<i>Meligethes fulvipes</i>	NS(Nb)	associated with Charlock and perhaps other yellow flowered Brassicaceae				x
Phalacridae						
<i>Olibrus aeneus</i>		flowers of various Compositae, especially Matricaria, Artemisia and Tanacetum	x			
Ptiliidae						
<i>Acrotrichis fascicularis</i>		grassland, sometimes woodland, on decaying vegetation	x	x		
Scaptiidae						
<i>Anaspis frontalis</i>		larvae in twigs of oak and other trees; adults at hawthorn blossom				x
Staphylinidae						
<i>Aloconota sulcifrons</i>		ecological associations are unclear				x
<i>Atheta (Atheta) crassicornis</i>		amongst detritus etc - ecology unclear				x
<i>Atheta (Mocytia) fungi</i>		a detritus-feeding rove beetle	x	x		
<i>Deleaster dichrous</i>	NS(Nb)	under stones, logs etc at the edge of wet areas				x
<i>Micropeplus staphylinoides</i>	Local	rotting vegetation, grass tussocks or occasionally on bare mud			x	

<i>Sepedophilus nigripennis</i>		grass tussocks, leaf litter, mosses and similar places		x		
<i>Stenus brunripes</i>		leaf litter, flood debris, tussocks etc	x			
<i>Stenus clavicornis</i>		disturbed grasslands	x	x		
<i>Stenus fulvicornis</i>		damp habitat, especially grazed grassland with Juncus	x	x		
<i>Stenus impressus</i>		amongst mosses, especially if damp		x		
<i>Stenus juno</i>		a common species in wet habitats	x	x		
<i>Stenus latifrons</i>		damp habitats		x		
<i>Stenus nanus</i>		hay bales, silage, hedgerows etc	x			
<i>Stenus ossium</i>		litter and moss - becoming rarer towards the north	x			
<i>Stenus picipes</i>		leaf litter, flood debris, tussocks etc, but mostly in woodlands		x		
<i>Tachyporus chrysomelinus</i>		grass litter and tussocks		x		
<i>Tachyporus nitidulus</i>		leaf litter, grass tussocks and similar micro-habitats	x		x	
DERMAPTERA						
Forficulidae						
<i>Forficula auricularia</i>		generalist species	x	x		
DIPTERA						
Agromyzidae						
<i>Cerodontha (Dizygomya) iridis</i>		mines leaves of Iris foetidissima			x	
<i>Phytomyza pullula</i>		mines leaves of Tripleurospermum maritimum and T. inodorum			x	
<i>Phytomyza ranunculi</i>		larva mines the leaves of Creeping Buttercup			x	
Anisopodidae						
<i>Sylvicola punctatus</i>		breeds in dung			x	
Anthomyiidae						
<i>Botanophila fugax</i>		ecological associations are unclear			x	
<i>Delia platura</i>		ecological associations are unclear				x
<i>Hylemya vagans</i>		trees - if more than one tree is present in a group the fly is usually also found				x
<i>Hylemya variata</i>		ecological associations are unclear			x	
<i>Pegoplatia aestiva</i>		ecological associations are unclear			x	
Bibionidae						
<i>Dilophus febrilis</i>		associated with dung			x	
Calliphoridae						
<i>Lucilia caesar</i>		carrion and dung			x	
<i>Lucilia illustris</i>		carrion and dung			x	
<i>Melanomyia nana</i>		larvae parasitise terrestrial woodlice				x
Ceratopogonidae						
<i>Seromyia femorata</i>		ecological associations are unclear			x	
Chloropidae						
<i>Chlorops hypostigma</i>		larvae feed in grass stems			x	
<i>Chlorops pumilionis</i>		ecology unclear - almost certainly a leaf miner in grasslands			x	
Dolichopodidae						
<i>Achalcus flavicollis</i>		associated with tussocks			x	
<i>Argyra diaphana</i>		frequent at woodland pools etc			x	
<i>Argyra leucocephala</i>		typically around puddles or ponds in woodland			x	x
<i>Argyra perplexa</i>		requires wet mud to breed			x	
<i>Campsicnemus curvipes</i>		damp mud, especially on saltmarshes			x	
<i>Chrysotus gramineus</i>		very common predatory grassland species			x	
<i>Dolichopus griseipennis</i>		damp grassland and scrub			x	
<i>Dolichopus plumipes</i>		requires wet mud to breed			x	
<i>Dolichopus popularis</i>		requires wet mud to breed			x	
<i>Dolichopus unguulatus</i>		larvae require damp habitat			x	
<i>Dolichopus urbanus</i>		requires wet mud to breed			x	
<i>Dolichopus vitripennis</i>		requires wet mud to breed			x	
<i>Rhaphium appendiculatum</i>		associated with wet habitats			x	
<i>Scellus notatus</i>	Local	predatory species in woodland and scrub, the adults			x	x

		predatory				
<i>Sympycnus desoutteri</i>		associated with wet habitats				x
<i>Syntormon pallipes</i>		larval ecology is unknown				x
Drosophilidae						
<i>Drosophila subobscura</i>		a saprophagous species				x
Dryomyzidae						
<i>Dryomyza (Neuroctena) anilis</i>		larvae feed in fungi				x
Empididae						
<i>Chelifera precatória</i>		associated with the water's- edge where there are also trees				x
<i>Chelipoda vocatoria</i>	Local	predatory species of damp habitats				x
<i>Dolichocephala oblongoguttata</i>	Local	ecology unclear				x
<i>Empis (Kritempis) livida</i>		predatory on other flies				x
Ephydriidae						
<i>Limmellia quadrata</i>		ecology unclear				x
<i>Scatella paludum</i>		ecology unclear				x
<i>Scatella stagnalis</i>		ecology unclear				x
Fanniidae						
<i>Fannia rondanii</i>		ecology unclear				x
<i>Fannia serena</i>		ecology unclear				x
Heleomyzidae						
<i>Heleomyza captiosa</i>	RDB K	ecology unclear				x
Hybotidae						
<i>Ocydromia glabricula</i>		larva feeds in dung and decaying vegetable matter				x
<i>Platypalpus exilis</i>		larva is predatory in leaf litter				x
<i>Platypalpus nigricornis</i>		ecology unclear				x
<i>Tachypeza nubila</i>		free-living predatory species, on rocks, tree trunks etc				x
<i>Trichina clavipes</i>		ecology unclear				x
Keroplidae						
<i>Orfelia lugubris (= tristis)</i>		grassland species				x
Lauxaniidae						
<i>Meiosimyza (Lyciella) rorida</i>		larvae feed amongst decaying vegetation				x
<i>Meiosimyza (Lyciella) subfasciata</i>		ecology unclear				x
Limoniidae						
<i>Dicranomyia autumnalis</i>		marshland and carr habitats				x
<i>Erioconopa trivialis</i>		marshes and muddy water margins, the larvae feeding in the mud				x
<i>Erioptera fuscipennis</i>		marshes and muddy water margins, the larvae feeding in the mud				x
<i>Erioptera lutea</i>		marshes and muddy water margins, the larvae feeding in the mud				x
<i>Gonomyia dentata</i>		damp areas, seepages and ditches on acid moorland				x
<i>Limonia flavipes</i>		woodland, mainly on calcareous soils. Larvae develop amongst litter				x
<i>Limonia nubeculosa</i>		woodland - the larvae feeding in leaf litter				x
<i>Molophilus appendiculatus</i>		wet woodland, the larvae developing in the soil				x
<i>Molophilus cinereifrons</i>		wet woodland, the larvae developing in the soil				x
<i>Pilaria discicollis</i>		wet habitats, the larvae are semi aquatic				x
<i>Rhipidia (Limonia) maculata</i>		larvae feed in herbivore dung				x
<i>Symplecta stictica</i>		wet marshes, meadows and saltmarshes				x
Lonchaeidae						
<i>Protearomyia nigra</i>		larval ecology unclear				x
Lonchopteridae						
<i>Lonchoptera lutea</i>		ubiquitous species in edge habitats, saprophagous larvae				x x
Muscidae						
<i>Coenosia agromyzina</i>		larval ecology unclear				x

<i>Graphomya maculata</i>		The larvae are aquatic; the attractive adults is most often seen at white umbel flowers			x	x
<i>Helina consimilis</i>		larval ecology unclear			x	
<i>Helina evecata</i>		larval ecology unclear			x	
<i>Hydrotaea cyrtoneurina</i>		larvae are soil-dwelling predators of smaller invertebrates			x	
<i>Limnophora triangula</i>	Local	larval ecology unclear			x	
<i>Lophosceles mutatus</i>	Local	larval ecology unclear			x	
<i>Morellia aenescens</i>		larvae feed in dung, preferring horse dung			x	
<i>Myospila mediatubunda</i>		larvae feed in cattle dung			x	x
<i>Phaonia angelicae</i>		larval ecology unclear; adults usually at flowers in edge habitats			x	
<i>Phaonia errans</i>		larval ecology unclear			x	
<i>Phaonia incana</i>		larval ecology unclear; adults usually at flowers			x	x
<i>Schoenomyza litorella</i>		damp, grassy places			x	
<i>Spilogona denigrata</i>		larval ecology unclear			x	
Mycetophilidae						
<i>Acnemia nitidicollis</i>		associated with fungi			x	
<i>Anatella unguigera</i>		associated with fungi			x	
<i>Boletina trispinosa</i>		associated with fungi			x	
<i>Coelosia tenella</i>		associated with fungi			x	
<i>Cordyla crassicornis</i>		larva feeds in Russula and Lactarius fungi			x	
<i>Mycetophila cingulum</i>		larva feeds in bracket fungus Polyporus squamosus			x	
<i>Mycetophila pumilla</i>		associated with fungi			x	
<i>Mycetophila strigata</i>		larva feeds in fungi - so far reared from Calocybe gambosa			x	
<i>Sceptonia fumipes</i>		associated with fungi			x	
<i>Synapha fasciata</i>		associated with fungi			x	
Opomyzidae						
<i>Opomyza germinationis</i>		larvae feed inside the stems of grasses			x	
Pallopteridae						
<i>Paloptera quinque maculata</i>		larvae feed in the stem bases of grasses			x	x
<i>Paloptera ustulata</i>		larva develops under bark			x	
Pediciidae						
<i>Pedicia rivosa</i>		larvae are predatory in bogs and marshes			x	
Piophilidae						
<i>Allopiophila vulgaris</i>		larvae feed in carrion			x	
Pipunculidae						
<i>Dorylomorpha confusa</i>		larval ecology unclear			x	
Psychodidae						
<i>Boreoclytocerus ocellaris</i>		larval ecology unclear			x	
<i>Pericoma trivialis</i>		standing water - even when polluted			x	
<i>Psychoda albipennis</i>		a saprophagous species			x	
<i>Psychoda phalaenoides</i>		larvae in cattle and horse dung			x	
Ptychopteridae						
<i>Ptychoptera albimana</i>		damp habitats, including seepages			x	
Rhagionidae						
<i>Chrysopilus cristatus</i>		damp habitats	x	x	x	
<i>Rhagio lineola</i>		woodland and scrub - especially at the edges			x	
Scathophagidae						
<i>Cordilura pubera</i>		associated with dung			x	
<i>Norellisoma spinimana</i>		larvae mine the stems of docks			x	
<i>Scathophaga furcata</i>		animal dung			x	
<i>Scathophaga lutaria</i>					x	
<i>Scathophaga stercoraria</i>		animal dung			x	x
<i>Scathophaga suilla</i>						x
<i>Spaziphora hydromyzina</i>					x	x
Sciaridae						
<i>Sciara hebes</i>					x	

Sciomyzidae						
<i>Tetanocera ferruginea</i>						x
<i>Tetanocera hyalipennis</i>		sallow and alder carr, preying on aquatic snails				x
<i>Tetanocera punctifrons</i>	NS(Nb)	predator of snails in damp areas near running water				x
<i>Tetanocera robusta</i>		predator of aquatic snails				x
Sepsidae						
<i>Nemopoda nitidula</i>		shade-loving species, larvae in dung and carrion				x
<i>Sepsis cynipsea</i>		Larvae feed in animal dung				x
<i>Sepsis orthocnemis</i>		larvae feed in dung, especially of cattle				x
<i>Sepsis violacea</i>		animal dung				x
Sphaeroceridae						
<i>Lotophila atra</i>		animal dung				x
<i>Opacifrons (Pseudocollinella) humida</i>		larvae in detritus of dried up marshes and streams				x
Stratiomyidae						
<i>Beris vallata</i>		saprophagous larvae				x
<i>Microchrysa cyaneiventris</i>		saprophagous larvae				x
Syrphidae						
<i>Arctophila superbiens (= fulva)</i>		aquatic larvae prefer muddy marginal zones				x
<i>Episyrphus balteatus</i>		ubiquitous species, partly immigrant, and a predator of aphids	x	x		x
<i>Eristalis lineata (= horticola)</i>		damp habitats, especially margins of ponds and woodland streams				x
<i>Eristalis nemorum (= interrupta)</i>		Larvae require damp habitats but adults are more or less ubiquitous	x			x
<i>Eupeodes corollae</i>		Grassland	x			
<i>Helophilus pendulus</i>		Larvae require damp habitats but adults are more or less ubiquitous	x	x		x
<i>Melanostoma mellinum</i>		Grassland	x			
<i>Melanostoma scalare</i>		Grassland	x	x		
<i>Neoascia obliqua</i>		semi-aquatic species in north and western Britain			x	
<i>Paragus haemorrhous</i>		bare or sparsely vegetated, dry sandy ground				x
<i>Platycheirus albimanus</i>		ubiquitous - larvae prey on aphids				x
<i>Platycheirus clypeatus</i>		Damp habitats	x	x		
<i>Platycheirus manicatus</i>		aphid predator amongst vegetation	x			
<i>Rhingia campestris</i>		Cow dung				x
<i>Sericomyia lapponica</i>		upland bogs			x	
<i>Sphaerophoria interrupta</i>		unimproved wet meadows and other wet grassy habitats				x
<i>Syrirta pipiens</i>		larvae in decaying vegetation; adults at flowers				x
<i>Xylota segnis</i>		Damp, dead wood	x			
Tabanidae						
<i>Haematopota pluvialis</i>		damp habitats - adult females are blood sucking horseflies				x
Tachinidae						
<i>Ocytata pallipes</i>		Parasitoid of earwigs				x
<i>Siphona geniculata</i>		parasitoid of craneflies				x
Tephritidae						
<i>Acidia cognata</i>	Local	Tussilago and Petasites plants - mining the leaves				x
<i>Tephritis vespertina</i>		larvae gall the flowers of Hypochaeris species				x
Tipulidae						
<i>Nephrotoma flavescens</i>		grassland, dunes and other habitats				x
<i>Tipula (Yamatipula) lateralis</i>		water's edge habitats, including seepages				x
<i>Tipula oleracea</i>		ubiquitous, larvae feeding on roots of grasses				x
<i>Tipula paludosa</i>		ubiquitous, larvae feeding on roots of grasses				x
<i>Tipula pruinosa</i>		marshy soil near streams; the larvae are semi-aquatic				x
<i>Vestiplex scripta</i>		most woodlands				x
HETEROPTERA						

Anthocoridae						
<i>Anthocoris nemoralis</i>		trees and shrubs		X		
<i>Anthocoris nemorum</i>		low vegetation	X		X	
Berytinidae						
<i>Berytinus minor</i>		clovers and trefoils, especially if slightly damp	X			
Lygaeidae						
<i>Scolopostethus decoratus</i>		associated with heate on heath and moor		X		
<i>Stygnocoris sabulosus</i>		disturbed ground amongst ruderal plants	X	X		
Miridae						
<i>Closterostomus norvegicus</i>		polyphagous			X	
<i>Lygus maritimus</i>		Chenopodiaceae - in coastal sites and inland ruderal sites	X			
<i>Lygus rugulipennis</i>		polyphagous - especially common in ruderal communities	X		X	
<i>Mecomma ambulans</i>		feeds on sap of sedges, rushes and other plants, as well as on animal matter		X		
<i>Plagiognathus arbustorum</i>		polyphagous, but usually associated with stinging nettles			X	
<i>Plagiognathus chrysanthemi</i>		polyphagous			X	
<i>Stenodema calcarata</i>		grasslands	X			
<i>Stenodema holsata</i>		grasslands, usually damp. Mainly northern and western	X	X	X	
<i>Stenodema laevigata</i>		grasslands	X			
Nabidae						
<i>Nabis flavomarginatus</i>		predatory species		X		
<i>Nabis limbatus</i>		marshy places	X			
Saldidae						
<i>Saldula orthochila</i>		predatory species of damp habitats	X			
Tingidae						
<i>Acalyptus parvula</i>		amongst moss in dry situations		X		
HOMOPTERA: AUCHENORHYNCHA						
Aphrophoridae						
<i>Neophilaenus lineatus</i>		grasslands	X	X	X	
<i>Philaenus spumarius</i>		larvae feed under froth on a wide range of herbaceous plants	X	X	X	
Cicadellidae						
<i>Agallia (Anaceratagallia) venosa</i>		on the ground amongst grasses in dry places			X	
<i>Anoscopus flavostriatus</i>		grassland		X		
<i>Aphrodes bicinctus</i>	Local	grasses in dry situations	X			
<i>Aphrodes makarovi</i>		on nettles, thistles and other plants in grasslands	X	X	X	
<i>Cicadella viridis</i>		grasses and rushes in marshy places	X		X	
<i>Elymana sulphurella</i>		dry grassland		X		
<i>Eupteryx urticae</i>		Usually on nettles	X		X	
<i>Macrosteles sexnotatus</i>		grassland species often associated with clovers	X			
<i>Megophthalmus scanicus</i>		associated with Fabaceae (clovers, trefoils, medics etc) in grassland	X	X		
<i>Psammotettix confinis</i>		grasses, including on post-industrial sites			X	
<i>Streptanus sordidus</i>		grasses in a range of habitats		X		
Cixiidae						
<i>Cixius nervosus</i>		most frequent in woodlands			X	
Delphacidae						
<i>Javesella pellucida</i>		grasses in a range of habitats	X		X	
<i>Muellerianella fairmairei</i>		damp grasslands	X	X		
HYMENOPTERA: ACULEATA						
Apidae						
<i>Apis mellifera</i>		the honey bee				
<i>Bombus lucorum</i>		more or less ubiquitous				

<i>Bombus pascuorum</i>		more or less ubiquitous				
Vespidae						
<i>Vespula vulgaris</i>		more or less ubiquitous				
LEPIDOPTERA: BUTTERFLIES						
Nymphalidae						
<i>Aphantopus hyperantus</i>		woodland edge and clearings, hedges and other edge habitats			x	
<i>Maniola jurtina</i>		grassland species			x	
Pieridae						
<i>Pieris napi</i>		ubiquitous			x	
LEPIDOPTERA: MOTHS						
Arctiidae						
<i>Spilosoma lubricipeda</i>	BAP(R)	herbaceous plants				x
<i>Spilosoma lutea</i>	BAP(R)	herbaceous plants and also trees and shrubs				x
Blastobasidae						
<i>Blastobasis lacticolella</i>		leaf litter				x
Geometridae						
<i>Acasis viretata</i>		Ivy, privet, dogwood and Viburnum opulus - usually on the flowers				x
<i>Biston betularia</i>		deciduous trees and herbaceous plants				x
<i>Cabera exanthemata</i>		Salix species and aspen				x
<i>Cabera pusaria</i>		deciduous trees				x
<i>Chiasmia clathrata</i>	BAP(R)	Medicago, Trifolium				x
<i>Chloroclysta truncata</i>		deciduous trees and herbaceous plants				x
<i>Colostygia pectinataria</i>		bedstraws				x
<i>Crocallis elinguarina</i>		deciduous trees				x
<i>Ecliptopera silaceata</i>	BAP(R)	willow herbs, enchanter's nightshade				x
<i>Eulithis prunata</i>		currants (<i>Ribes</i> species)				x
<i>Eupithecia pulchellata</i>		Foxglove				x
<i>Hydriomena furcata</i>		Salix species				x
<i>Idea biselata</i>		dandelion, plantain, Polygonum etc				x
<i>Lomaspilis marginata</i>		sallow, willow, poplar - rarely hazel				x
<i>Opisthograptis luteolata</i>		deciduous trees				x
<i>Scotopteryx chenopodiata</i>	BAP(R)	vetches and clovers				x
<i>Scotopteryx luridata</i>		Associated with Gorse and <i>Genista anglica</i>				x
<i>Selenia dentaria</i>		deciduous trees				x
<i>Xanthorhoe designata</i>		Brassica napus				x
<i>Xanthorhoe ferrugata</i>	BAP(R)	herbaceous plants				x
<i>Xanthorhoe fluctuata</i>		Cruciferae				x
<i>Xanthorhoe montanata</i>		herbaceous plants - especially bedstraws				x
Hepialidae						
<i>Hepialus fusconebulosa</i>		bracken			x	x
<i>Hepialus humuli</i>	BAP(R)	roots of grasses and herbaceous plants			x	
Noctuidae						
<i>Abrostola tripartita</i>		nettles				x
<i>Abrostola triplasia</i>		stinging nettle and hop				x
<i>Acronicta psi</i>	BAP(R)	deciduous trees and bushes				x
<i>Apamea crenata</i>		grasses				x
<i>Apamea monoglypha</i>		grasses			x	x
<i>Apamea remissa</i>	BAP(R)	grasses				x
<i>Autographa gamma</i>		nettles and other herbaceous plants - rarely surviving winter. Immigrants from Europe are regular			x	x
<i>Autographa pulchrina</i>		herbaceous plants, especially stinging nettle				x
<i>Celaena leucostigma</i>	BAP(R)	<i>Iris pseudacorus</i> , and probably other wetland plants				x
<i>Chortodes pygmina</i>		grasses, sedges and rushes, feeding in the flowering stems				x
<i>Cosmia trapezina</i>		deciduous trees				x
<i>Diarsia mendica</i>		shrubs and herbaceous plants				x

<i>Euplexia lucipara</i>		bracken and other ferns				x
<i>Hadena bicruris</i>		Silene and Lychnis - in the seed capsules				x
<i>Hypena proboscidalis</i>		nettles				x
<i>Luperina testacea</i>		grasses				x
<i>Lycophotia porphyrea</i>		heather				x
<i>Melanchra pisi</i>	BAP(R)	widely polyphagous, including on bracken				x
<i>Mesapamea secalis</i>		grasses				x
<i>Mythimna ferrago</i>		grasses			x	
<i>Mythimna impura</i>		grasses			x	
<i>Noctua comes</i>		herbaceous plants			x	x
<i>Noctua janthe</i>		herbaceous plants				x
<i>Noctua pronuba</i>		herbaceous plants			x	x
<i>Ochropleura plecta</i>		herbaceous plants			x	x
<i>Oligia fasciuncula</i>		grasses				x
<i>Oligia latruncula</i>		grasses				x
<i>Photedes minima</i>		Tufted Hair-grass - in the stems				x
<i>Plusia festucae</i>		herbaceous plants and grasses, especially those characteristic of marshy places			x	
<i>Rusina ferruginea</i>		herbaceous plants			x	
<i>Stilbia anomala</i>	BAP(R)	grasses, especially Deschampsia cespitosa				x
<i>Xanthia icteritia</i>	BAP(R)	sallow/willow catkins - then on herbaceous plants				x
<i>Xestia baja</i>		first on herbaceous plants then after diapause on deciduous trees and shrubs				x
<i>Xestia xanthographa</i>		grasses and herbaceous plants then trees in the spring	x			x
Notodontidae						
<i>Notodonta dromedarius</i>		birch, occasionally alder or hazel				x
<i>Notodonta ziczac</i>		poplars and sallows/willows				x
<i>Pheosia gnoma</i>		birch				x
<i>Pheosia tremula</i>		poplars and sallows/willows				x
<i>Ptilodon capucina</i>		deciduous trees				x
Pterophoridae						
<i>Platyptilia gonodactyla</i>		Coltsfoot				x
Pyralidae						
<i>Agriphila straminella</i>		grasses				x
<i>Agriphila tristella</i>		grasses				x
<i>Crambus lathoniellus</i>		grasses				x
<i>Udea lutealis</i>		herbaceous plants				x
<i>Udea olivalis</i>		herbaceous plants				x
<i>Udea prunalis</i>		herbaceous plants, trees and bushes				x
Sphingidae						
<i>Deilephila elpenor</i>		rosebay willow-herb				x
<i>Laothoe populi</i>		poplars and sallows/willows			x	x
Thyatiridae						
<i>Thyatira batis</i>		bramble				x
Tortricidae						
<i>Epiblema sticticana</i>		in the roots and stem of Coltsfoot				x
<i>Eucosma cana</i>		thistles and Centaurea nigra - in the flower head				x
MYRIAPODA: DIPLOPODA						
Julidae						
<i>Cylindroiulus punctatus</i>		a woodland species, sometimes associated with non-woodland trees	x			
<i>Tachypodoiulus niger</i>		many habitats and often found climbing trees	x			
NEUROPTERA						
Chrysopidae						
<i>Chrysoperla carnea</i>		aphid predator of trees and bushes	x	x		
Hemerobiidae						
<i>Micromus variegatus</i>		probably a predator of root aphids			x	
ODONATA						
Coenagriidae						

<i>Enallagma cyathigerum</i>		static, open water bodies with emergent vegetation, flying mid May to early October			x	
Lestidae						
<i>Lestes sponsa</i>		static water-bodies fringed with rushes, the adults flying from late June to September			x	
PLECOPTERA						
Leuctridae						
<i>Leuctra inermis</i>		stony rivers and streams, mostly northern and at raised altitude			x	
PSOCOPTERA						
Caeciliusidae						
<i>Epicaecilius pilipennis</i>		Tree trunk-dwelling species			x	
Ectopsocidae						
<i>Ectopsocus petersi</i>		associated with trees and bushes			x	

APPENDIX 2: INVERTEBRATE STATUS CODES

Earlier published reviews of scarce and threatened invertebrates employed the Red Data Book criteria used in the British Insect Red Data Book (Shirt 1987) with the addition of the category RDBK (Insufficiently Known) after in 1983. In addition, the status category Nationally Notable (now termed Nationally Scarce) was used from 1991. The original criteria of the International Union for the Conservation of Nature (IUCN – now called the World Conservation Union) for assigning threat status used in these publications had the categories *Endangered*, *Vulnerable*, and *Rare*, which were defined rather loosely and without quantitative parameters. The application of these categories was largely a matter of subjective judgment, and it was not easy to apply them consistently within a taxonomic group or to make comparisons between groups of different organisms. The deficiencies of the old system were recognised internationally, and in the mid-1980s proposals were made to replace it with a new approach which could be more objectively and consistently applied. In 1989, the IUCN's Species Survival Commission Steering Committee requested that a new set of criteria be developed to provide an objective framework for the classification of species according to their extinction risk. The first, provisional, outline of the new system was published in 1991. This was followed by a series of revisions, and the final version adopted as the global standard by the IUCN Council in December 1994. The guidelines were recommended for use also at the national level. In 1995, the Joint Nature Conservation Committee (JNCC) endorsed their use as the new national standard for Great Britain, and subsequent British Red Data Books have used these revised IUCN criteria. These criteria are used in this present report and are as follows:

EXTINCT (EX) A species is *Extinct* when there is no reasonable doubt that the last individual has died.

EXTINCT IN THE WILD A species is *Extinct* in the wild when it is known to survive only in cultivation, in captivity or as a naturalised population (or populations) well outside the past range.

CRITICALLY ENDANGERED

A species is *Critically Endangered* when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the following criteria:

A. Population reduction in the form of either of the following:

1. An observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on direct observation, an index of abundance appropriate for the species, a decline in area of occupancy, extent of occurrence and/or quality of habitat, actual or potential levels of exploitation or the effects of introduced species, hybridisation, pathogens, pollutants, competitors or parasites.
2. A reduction of at least 80%, projected or suspected to be met within the 10 years or three generations, whichever is the longer, based on any of these parameters.

B. Extent of occurrence estimated to be less than 100 Km² or areas of occupancy estimated to be less than 10 Km² and estimates indicating any two of the following:

1. Severely fragmented or known to exist at only a single location.
2. Continuing decline, observed, inferred or projected, in any of the following: a. extent of occurrence b. area of occupancy c. area, extent and/or quality of habitat d. number of locations or sub-populations e. number of mature individuals
3. Extreme fluctuations in extent of occurrence, area of occupancy, number of locations or sub-populations or number of mature individuals.

C. Population estimated to number less than 250 mature individuals and either:

1. An estimated continuing decline of at least 25% within 3 years or one generation, whichever is longer or
2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either severely fragmented (*i.e.* no sub-population estimated to contain more than 50 mature individuals) or all individuals are in a single sub-population

D. British population estimated to number less than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild of at least 50% within 10 years or 3 generations, whichever is the longer.

ENDANGERED (Formerly RDB category 1)

A species is Endangered when it is not *Critically Endangered* but is facing a very high risk of extinction in the wild in the near future, as defined by any of the following criteria:

A. Population reduction in the form of either of the following:

1. An observed, estimated, inferred or suspected reduction of at least 50% over the last 10 years or three generations, whichever is the longer, based on direct observation, an index of abundance appropriate for the species, a decline in area of occupancy, extent of occurrence and/or quality of habitat, actual or potential levels of exploitation or the effects of introduced species, hybridisation, pathogens, pollutants, competitors or parasites.
2. A reduction of at least 50%, projected or suspected to be met within the 10 years or three generations, whichever is the longer, based any of these parameters.

B. Extent of occurrence estimated to be less than 5,000 Km² or areas of occupancy estimated to be less than 10 Km² and estimates indicating any two of the following:

1. Severely fragmented or known to exist at no more than five locations.
2. Continuing decline, observed, inferred or projected, in extent of occurrence, area of occupancy, area, extent and/or quality of habitat, number of locations or sub-populations or the number of mature individuals.

C. Population estimated to number less than 2500 mature individuals and either:

1. An estimated continuing decline of at least 20% within 5 years or 2 generations, whichever is longer or
2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either severely fragmented (*i.e.* no sub-population estimated to contain more than 250 mature individuals) or all individuals are in a single sub-population

D. British population estimated to number less than 250 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild of at least 20% within 20 years or 5 generations, whichever is the longer..

VULNERABLE (Formerly RDB category 2)

A species is *Vulnerable* when it is not *Critically Endangered* or *Endangered* but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the following criteria (A to E):

A. Population reduction in the form of either of the following:

1. An observed, estimated, inferred or suspected reduction of at least 20% over the last 10 years or three generations, whichever is the longer, based on direct observation, an index of abundance appropriate for the species, a decline in area of occupancy, extent of occurrence and/or quality of habitat, actual or potential levels of exploitation or the effects of introduced species, hybridisation, pathogens, pollutants, competitors or parasites.
2. A reduction of at least 20%, projected or suspected to be met within the 10 years or three generations, whichever is the longer, based any of these parameters.

B. Extent of occurrence estimated to be less than 20,000 Km² or areas of occupancy estimated to be less than 20,000 Km² and estimates indicating any two of the following:

1. Severely fragmented or known to exist at no more than ten locations. Continuing decline, observed, inferred or projected, in extent of occurrence, area of occupancy, area, extent and/or quality of habitat, number of locations or sub-populations or the number of mature individuals.
2. Extreme fluctuations in extent of occurrence, area of occupancy, number of locations or sub-populations or number of mature individuals.

C. Population estimated to number less than 10,000 mature individuals and either:

1. An estimated continuing decline of at least 10% within 10 years or 3 generations, whichever is longer or
2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either severely fragmented (*i.e.* no sub-population estimated to contain more than 1000 mature individuals) or all individuals are in a single sub-population

D. Population very small or restricted in the form of either of the following:

1. Population estimated to number less than 1,000 mature individuals.
2. Population is characterised by an acute restriction in its area of occupancy (typically less than 100 km) or in the number of locations (typically less than 5). Such a species would thus be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and is thus capable of becoming *Critically Endangered* or even *Extinct* in a very short period.

E. Quantitative analysis showing the probability of extinction in the wild of at least 10% within 100 years.

LOWER RISK (Formerly RDB category 3)

A species is Lower Risk when it has been evaluated but does not satisfy the criteria for any of the categories *Critically Endangered*, *Endangered* or *Vulnerable*. Species included in the Lower Risk category can be separated into three sub-categories:

- **Conservation Dependent** species which are the focus of a continuing species -specific or habitat-specific conservation program targeted towards the species in question, the cessation of which would result in the species qualifying for one of the threatened categories above within a period of five years.
- **Near Threatened** Species which do not qualify for *Lower Risk (Conservation Dependent)*, but which are close to qualifying for *Vulnerable*.
- **Least Concern**
Species which do not qualify for *Lower Risk (Conservation Dependent)* or *Lower Risk (Near Threatened)*.

DATA DEFICIENT A species is *Data Deficient* when there is inadequate information to make a direct or indirect assessment of its risk of extinction based on its distribution and/or population status. A species in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. *Data Deficient* is therefore not a category of threat or Lower Risk.

LOWER RISK (NATIONALLY SCARCE – FORMERLY NATIONALLY NOTABLE)

Species which are not included within the IUCN threat categories and are estimated to occur less than 100 hectads of the Ordnance Survey national grid in Great Britain. It should be noted that Lower Risk (Nationally Scarce) is not a threat category, but rather an estimate of the extent of distribution of these species. Lower Risk species are subdivided as follows:

- Na** species estimated to occur within the range of 16 to 30 10-kilometre squares of the National Grid System.
- Nb** species estimated to occur within the range 31 to 100 10-kilometre squares of the National Grid System.
- N** Diptera (flies) not separated, falling into either category Na or Nb.

NATIONALLY LOCAL (L)

Species which, whilst fairly common, are evidently less widespread than truly common species, but also not qualifying as Nationally Notable having been recorded from over one hundred, but less than three hundred, ten-kilometre squares of the UK National Grid.

ASSOCIATED DEFINITIONS

Extent of occurrence

Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a species, excluding cases of vagrancy. This measure may exclude discontinuities or disjunctions within the overall distributions of species (e.g. large areas of obviously unsuitable habitat) (but see 'area of occupancy'). Extent of occurrence can often be measured by a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180 degrees and which contains all the sites of occurrence).

Area of occupancy

Area of occupancy is defined as the area within its 'extent of occurrence' (see definition) which is occupied by a species, excluding cases of vagrancy. The measure reflects the fact that a species will not usually occur throughout the area of its extent of occurrence, which may, for example, contain unsuitable habitats. The area of occupancy is the smallest area essential at any stage to the survival of existing populations of a species (e.g. colonial nesting sites, feeding sites for migratory species). The size of the area of occupancy will be a function of the scale at which it is measured, and should be at a scale appropriate to relevant biological aspects of the species. The criteria include values in km², and thus to avoid errors in classification, the area of occupancy should be measured on grid squares (or equivalents) which are sufficiently small.